Human Renal Transplantation, II*

A Successful Case of Homotransplantation of the Kidney Between Identical Twins

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• **Kidney transplantation between 41-year-old twin men was carried out because of chronic glomerulonephritis in one twin. The operation was successful. Hypertension, edema and azotemia in the patient disappeared after operation and both the donor and the recipient were well.**

RENAL TRANSPLANTATION between identical twins, first performed successfully at the Peter Bent Brigham Hospital in Boston in the fall of 1954 as an exciting clinical experiment, is now an accepted procedure, provided the indications are proper and the donor is able to give the kidney without jeopardizing his own life.[8,10]

Approximately 25 transplantations of kidneys between twins have been done since the first successful case in Boston. There have been two successful cases of kidney transplantation between non-identical twins.[10] There have been no permanently successful "takes" of kidney transplantation between persons who are not twins, although Hamburger of Paris recently described a successful case of transplantation of a kidney from mother to son with survival for more than a year.[4] One of the most recent reports of successful kidney transplantation between identical twins is by Woodruff of Edinburgh.[10] An excellent recent review of the literature was prepared by Menville and co-workers.[6]

To the present, so far as we could determine, only three successful kidney homotransplantations have been performed in the Western United States. The first of these was done by Hodges, Murray and Dunphy in Portland in October 1959.[5] The second, done at Stanford in August of 1960, was reported by Cohn and coworkers.[1]

The purpose of this paper is to describe our successful experience with homotransplantation of a kidney between identical twins performed at the University of California Medical Center in Los Angeles on July 15, 1961. Our experiences with non-twin renal homotransplantations are reported elsewhere.[2,3]

REPORT OF A CASE

The subjects, A and B, were 41-year-old, married, white, identical male twins. A, the sick twin, had no previous history of renal disease and no symptoms until about September 1959 when albuminuria and pyuria were first noted at an insurance examination. Subsequently, hypertension, edema and azotemia developed. Since he had rather far advanced renal disease and was known to have an identical twin, he was referred to UCLA for evaluation and consideration for renal homotransplantation.

The patient was admitted for evaluation on three

TABLE 1.—*Renal Transplantation—Identical Twins (Preoperative Studies)*

Clinical Features	Twin A (Recipient)	Twin B (Donor)
Blood pressure	160/100 mm. mercury	115/65
Fundi	Macular star	Normal
Heart	PMI MCL 5th interspace	Normal
Renogram	Decided impairment	Normal
Electrocardiogram	LVH	Frequent PVC's
Hematocrit	26%	47%
Blood urea nitrogen	92.4 mg. %	12.5 mg. %
Serum creatinine	9.0 mg. %	1.0 mg. %
Urine protein	5.8 gm. /24°	None

PMI=Point of maximal impulse; MCL=Midclavicular line; PVC=Premature ventricular contraction; LVH=Left ventricular hypertrophy.

TABLE 2.—*Renal Transplantation—Identical Twins (Preoperative Renal Function)*

Renal Functions	Twin A (Recipient)	Twin B (Donor)
Maximum specific gravity	1.016	1.021
Maximum osmolarity	332 mosm.	723 mosm.
Minimum specific gravity	1.010	1.000
Minimum osmolarity	262 mosm.	133 mosm.
Creatinine clearance	9.9 ml./min.	119 ml./min.
Insulin clearance	10.0 ml./min.	105 ml./min.
Para-aminohippuric acid clearance	19.9 ml./min.	492 ml./min.
Phenolsulfonphthalein 15'	1%	45%
total	7%	77.5%

*This is the second of three articles on this subject.[2,3]

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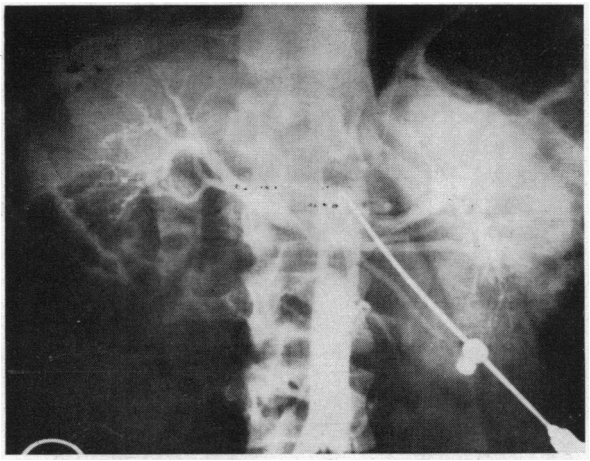

Figure 1.—Aortogram of donor. Note duplication of left renal artery and small polar artery on the right side with fairly normal right renal artery. This information led to decision to use the right kidney of the donor.

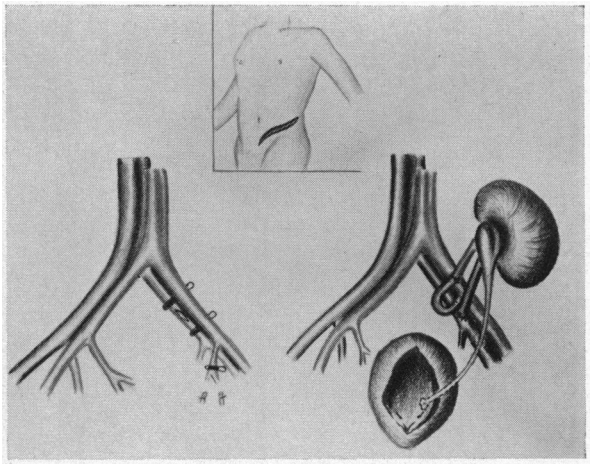

Figure 2.—Technique of transplantation of right kidney of donor to left iliac fossa of recipient. The renal artery, which was posterior in the normal position, now lies anteriorly to match the position of the hypogastric artery in relation to the iliac vein. Note end-to-end anastomosis of hypogastric artery to renal artery and end-to-side anastomosis of renal vein to iliac vein.

occasions before transplantation was finally carried out. On one admission digitalization was carried out because of congestive heart failure due to rapidly advancing hypertension. Laboratory studies showed hemoglobin of 6.8 grams per 100 cc., serum creatinine of 9.0 mg. per 100 cc., and he had mild acidosis with a carbon dioxide combining power of 17.9 mEq. An electrocardiogram was interpreted as showing left ventricular hypertrophy (see Table 1).

Historical and photographic evidence suggested that the twins were identical. In blood cross-matching of the patient with his brother, ten groups agreed exactly. Finger prints were almost identical and crossgrafting of skin was successful. The twins had identical defects in color vision, and both were nonreactive to phenylthiocarbonamide.

The sick twin's maximum urinary concentration was 1.014 specific gravity with an osmolarity of 332. Addis counts showed 200,000 casts, 16 million white blood cells and 298 million red blood cells. Phenolsulfonphthalein excretion was 2 per cent in two hours. Creatinine clearance was 9.9 cc. per minute and inulin clearance was 10 cc. per minute. Para-aminohippuric acid clearance was 19.9 cc. per minute. A radioactive renogram showed decided bilateral impairment (see Table 2). Renal biopsy was not done. The clinical diagnosis was chronic glomerulonephritis.

At the time of admission for transplantation on July 14, Twin A had a serum creatinine level of 12.7 mg. per 100 cc.

After transfusion of several units of packed red blood, the patient was considered ready for transplantation of a kidney from Twin B, who meanwhile had been studied extensively. Results of renal function studies were considered to be normal. On one occasion he was found to have some red blood cells in the urine. Because of concern over this, it was decided to do a needle biopsy of his right kidney. The biopsy was considered normal.

In order to check the blood supply of the kidneys an aortogram was performed at the time of admission for evaluation. It showed that he had duplication of the renal arteries on the left side in such a way as to require a double anastomosis of two relatively small arteries. On the right side there was a large main renal artery and a tiny lower polar artery which seemed insignificant (Figure 1). Because of this, we elected to use the right kidney of the donor and to place it in the left hypogastric fossa of the recipient.

Operation

Two teams worked in adjacent rooms. One team removed the right kidney from the donor and the other team prepared the recipient. In general, the technique followed was that originated by Hume and Murray and the Peter Bent Brigham group, in which the kidney is placed in the iliac fossa of the recipient on the opposite side from which it was removed from the donor.

Heparin was not used. After the kidney was removed from the donor, it was placed on a cold, wet towel in a bath of iced saline solution. It is believed that refrigeration protects the kidney during the period of ischemia.

The recipient was prepared by approaching the left iliac area through a low transverse abdominal incision. The left hypogastric artery was dissected

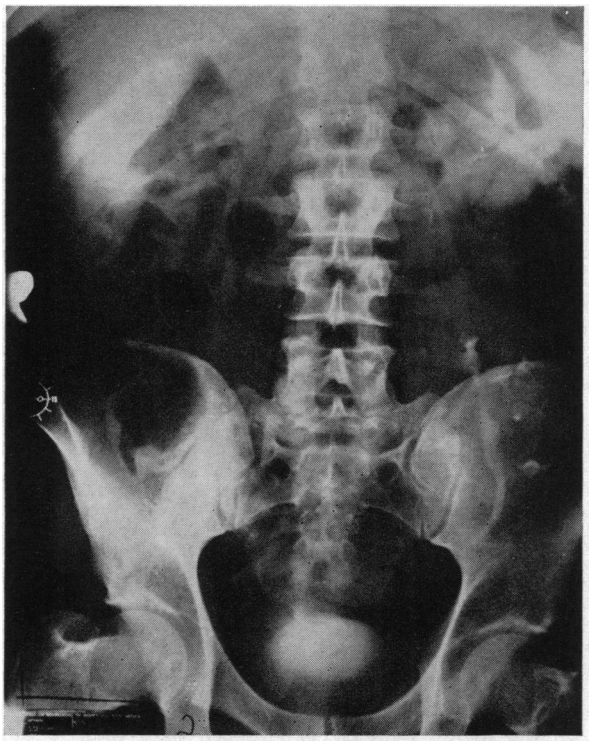

Figure 3.—Postoperative intravenous pyelogram showing transplanted kidney lying in the left iliac fossa.

free with all its branches, which were ligated and transected. When it was demonstrated that the donor kidney had in fact only one major artery, the excess branches of the hypogastric artery were excised; and end to end arterial anastomosis between the left hypogastric artery and the renal artery was done. The renal vein was joined to the left iliac vein, end to side (Figure 2).

Owing to technical difficulty caused by the presence of an arteriosclerotic plaque, the arterial anastomosis had to be repeated twice. The total time of renal ischemia was 106 minutes. However, the procedure was ultimately successful and a copious output of urine began shortly after the blood supply was restored—375 cc. in the first twenty minutes.

The ureter was joined to the bladder by a tunnelling technique. A splinting ureteral catheter and a cystostomy tube were brought out through the suprapubic incision. The kidney was placed above the bladder and to the left in the hypogastric fossa behind the peritoneum (Figure 3). Before closure was completed, the kidney was partially decapsulated by making cruciate incisions in the capsule. This was done to diminish the effects of postoperative edema within the tight renal capsule. There was minimal bleeding.

The initial postoperative course of both patients was interesting. The recipient had pronounced di-

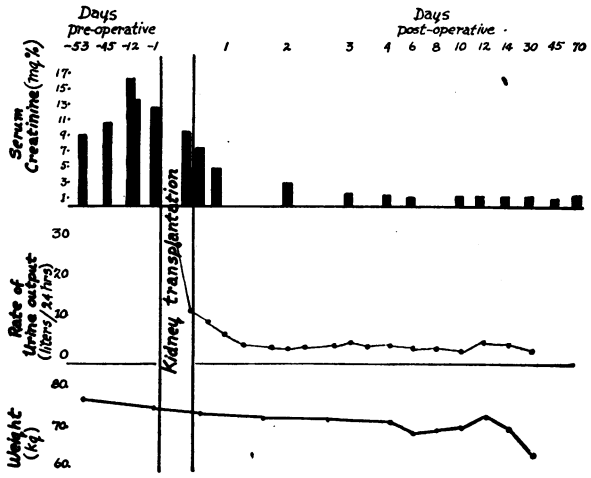

Chart 1.—Changes in serum creatinine and urine flow.

uresis with concomitant weight loss. He excreted 9550 cc. of urine from the ureteral catheter in the first 24 hours. The serum creatinine fell from 12.7 mg. per 100 cc. immediately after the operation to 9.3 mg. after four hours, 4.8 mg. after 18 hours and 1.75 mg. per 100 cc. 72 hours after the procedure (Chart 1). Fluids and electrolytes were replaced intravenously according to serum and urine determinations. Immediately after the operation serum calcium was 4.1 mEq. per liter and phosphorus 11.3 mEq. Within 72 hours, the serum calcium was 4.43 mEq. and the serum phosphorus had fallen to 1.3 mEq. (Chart 1). Severe left flank tenderness and fever developed in the recipient. It was thought that the tenderness was due to obstruction of the remaining left ureter and kidney. Phensolsulfonphthalein clearance from the transplanted kidney on the fourth postoperative day was 30 per cent in two hours. Later it rose to 50 per cent.

Pulmonary infarction developed in both twins, mild in the right lower lobe of the donor and more extensive in the left lower lobe of the recipient. Otherwise the donor's recovery was uneventful. Despite maintenance of anticoagulant therapy, deep thrombophlebitis developed in the left leg of the recipient, possibly related to obstruction of the iliac vein during the time of transplantation. A wound abscess developed and was subsequently drained. The patient was discharged from the hospital in good condition on August 17, 1961.

The recipient was readmitted on September 1, six weeks after the transplantation. Both of his own diseased kidneys were removed simultaneously by means of a posterior approach with the patient in the prone position. They were extensively damaged with advanced glomerulonephritis.

TABLE 3.—*Renal Transplantation—Identical Twins (Recipient, Before and After Transplantation)*

Renal Functions	Preoperative	Postoperative
Maximum specific gravity	1.016	1.020
Maximum osmolarity	332 mosm.	684 mosm.
Serum creatinine	9.0 mg. %	1.1 mg. %
Creatinine clearance	9.9 ml./min.	56 ml./min.
Phenolsulfonphthalein 15'	1%	15%
total	7%	35%
Hematocrit	26%	48%
Urine protein	5.8 gm. /24°	0.1 gm. /24°

On the right side the twelfth rib was removed for better exposure, and thus fortuitously the recipient again resembled his identical twin brother, whose twelfth rib was removed at the time of nephrectomy when he gave the "donor kidney."

Subsequently renal function studies showed the function to be the same in the two kidneys, one in each twin. The hypertension of the patient disappeared.

The donor developed a peptic ulcer which responded to medical management. One may speculate as to the role of surgical stress in this event.

Both twins are now in excellent health and have resumed their normal lives, and are back at work in their photography shops. The prognosis of the previously doomed patient should be excellent.

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